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Discussion

Dr T. Sundt *(Rochester, Minn)*. I congratulate the authors on doing this study. A prospectively randomized study isn't an easy thing to do. I guess I should add that my only conflict of interest is that I have less concern about the controversy over on-pump versus off-pump than I have about the use of arterial grafts. I think as a group, cardiac surgeons would have done well to put more of our energy into understanding the role of arterial grafts.

Nonetheless, the controversy over off-pump surgery continues, and this is an important article. The fact that the controversy continues begs the question ''Why is it that after over a decade of exploring this matter, the adoption of off-pump surgery is still pretty modest?'' Today, only approximately 20% of coronary revascularizations are done off-pump despite multiple retrospective studies that have suggested a benefit to eliminating the pump. Why is that? Part of the answer is that most of the randomized studies performed thus far have demonstrated a relatively modest advantage to the off-pump strategy, including little neurocognitive benefit and a modest mortality benefit if any at all. The advocates of the off-pump approach point to reductions in blood transfusion requirements and ICU length of stay, but up to now, little has been shown with regard to the outcome that most grabs our attention: mortality. The reason for this disconnect between retrospective and prospective studies on this subject is the same as the reason that it is difficult to show a difference in mortality rate between PCI and coronary bypass. As David Taggert has argued vehemently, it is the low-risk patients who are entered into the randomized studies, and if low-risk patients are entered into randomized studies, you are unlikely to see a mortality benefit regardless of what you do! So I congratulate you in particular in taking the necessary step in entering the high-risk patients. They are indeed the ones in whom we might expect to see a difference in mortality, and you have successfully demonstrated that. This is an important step.

With those comments, I have just a couple of questions. It is a well-written and beautifully presented article. One question is in regard to the randomization process. Were the same surgeons doing the on-pump and off-pump cases? If they were not, then it could be that more skilled surgeons were doing the off-pump cases than the on-pump cases, and in fact we are looking at a surrogate for surgical skill.

Dr Fattouch. This work is part of our experience in the high-risk patients with STEMI who underwent CABG at our institution. We started this experience at the University of Palermo in 2002, and since the beginning of our experience, in collaboration with interventional cardiologists in the West Sicily district, we aimed to treat these patients. Encouraged by our initial results obtained with off-pump CABG, we designed this randomized study to evaluate the effects of off-pump versus on-pump CABG in high-risk patients with STEMI who underwent CABG in the early phase. We started this study because our opinion about the superiority of off-pump CABG in patients with STEMI is supported by the fact that avoiding CPB, and not only the conventional cardioplegic arrest, leads to

less activation on the inflammatory cascade and less deposit into the microvasculature of monomorphonuclear cells, which have an important role in postoperative reperfusion/ischemia damage. Moreover, the postoperative improvement of myocardial function that was observed in the patients who underwent off-pump surgery is due to the fact that in on-pump surgery the heart is empty and in an empty heart the left ventricular wall geometry change leads to impedance of coronary collateral flow supplying ischemic areas of myocardium. The patency of these collaterals is important in these patients to limit the extension of the area of ischemic myocardial damage. Moreover, it has been shown that normal interventricular septum movement is better preserved after off-pump surgery, which improves LV function. Finally, we have a team dedicated for this type of surgery, and all cases were done by the same team of surgeons with high expertise in coronary artery surgery and specifically in off-pump CABG.

Dr Sundt. A second question would be about the number of grafts per patient. They are clearly similar between both groups but rather modest, less than 3 grafts per patient in both cases. Do you have data about the number of diseased vessels and completeness of revascularization, or is the low number of grafts a reflection of the patients' extremis? Do you tend to minimize the number of grafts in these patients? Is this a low number for you?

Dr Fattouch. In our series, the mean number of grafts per patient was 2.8 in the on-pump group and 2.6 in the off-pump group; they are clearly similar between both groups without a statistically significant difference. So, I agree with you that less than 3 grafts per patient could seem modest but reflects honestly what we observed. In these high-risk patients with STEMI, sometimes with cardiac shock, life-threatening arrhythmias, and multivessel disease, our policy was to perform complete myocardial revascularization.

Dr Sundt. Do you know what percentage of patients with AMI from your network wound up coming to the operating room? We just don't see it very often. It is uncommon for us to see a patient in the operating room with an AMI. Most of them are rescued in the catheter laboratory.

Dr Fattouch. The overall incidence of patients with STEMI who need early urgent or emergency CABG is approximately 3% to 4% among all patients who have an AMI. To answer the second part of your question, I think that we observed this high number of patients at our institution because we have a district network for the treatment of these patients in collaboration with cardiologists working in several coronary ICUs and catheter laboratories since 2002. So, in our institution we operated on more than 300 patients in the evolving phase of STEMI, and the results are acceptable.

Dr P. Kurlansky *(Miami, Fla).* I also congratulate you on conducting an extremely difficult study. The use of cardioplegic arrest not only provides the opportunity for operating in a silent, bloodless field but also provides the opportunity for substrate enhancement, which may be particularly relevant to this particular group of patients who are acutely ischemic. In your experience or in the study, was anything done specifically to alter the mechanisms or methodology of cardioplegia to provide specific substrate enhancement for this particularly ill group of patients.?

Dr Fattouch. I think that off-pump CABG is better and superior to on-pump in these patients because by using an intracoronary shunt, you can conserve the native blood flow and the opportunity to supply substrate to the ischemic myocardium. However, in the case of occluded vessel, I think that a delay for 10 minutes in the beating heart, the time we need to put the graft and supply blood flow, is not an additional risk factor for ischemic myocardium. So, it is evident that in this case we must first address the occluded guilty vessel. Finally, in patients undergoing on-pump CABG, we use blood cardioplegia under a normothermic CPB, which is the best option, in our opinion. Currently, we avoid the use of CPB for all of the reasons that I have discussed with Dr Sundt.